WATER SUPPLY OUTLOOK
and
FEDERAL - STATE - PRIVATE COOPERATIVE SNOW SURVEYS
for
WESTERN UNITED STATES
Including Columbia River Drainage in Canada

UNITED STATES DEPARTMENT of AGRICULTURE···SOIL CONSERVATION SERVICE
Collaborating with
CALIFORNIA DEPARTMENT of WATER RESOURCES
and
BRITISH COLUMBIA DEPARTMENT of
LANDS, FORESTS and WATER RESOURCES

AS OF
MAY 1, 1964

UNITED STATES DEPARTMENT OF AGRICULTURE - SOIL CONSERVATION SERVICE

To Recipients of Water Supply Outlook Reports:

The climate of the cultivated and populated areas of the West is characterized by relatively dry summer months. Such precipitation as occurs falls mostly in the winter and early spring months when it is of little immediate benefit to growing crops. Most of this precipitation falls as mountain snow which stays on the ground for months, melting later to sustain streamflow during the period of greatest demand during late spring and summer. Thus, nature provides in mountain snow an imposing water storage facility.

The amount of water stored in mountain snow varies from place to place as well as from year to year and accordingly, so does the runoff of the streams. The best seasonal management of variable western water supplies results from advance estimates of the streamflow.

A snow survey consists of a series of about ten samples taken with specially designed snow sampling equipment along a permanently marked line, up to 1000 feet in length, called a snow course. The use of snow sampling equipment provides snow depth and water equivalent values for each sampling point. The average of these values is reported as the snow survey measurement for a snow course.

Snow surveys are made monthly or semi-monthly beginning in January or February and continue through the snow season until April, May or June. Currently more than 1400 western snow courses are measured each year. These measurements furnish the key data for water supply forecasts.

Streamflow forecasts are obtained by a comparison of total or maximum snow accumulation, as measured by snow water equivalent, to the subsequent spring and summer or snowmelt season runoff over a period of years. The snow water equivalent measured in selected snow courses provides most of the index to the streamflow forecast for the following season. More accurate forecasts are usually obtained when other factors such as soil moisture, base flow and spring precipitation are considered and included in the forecast procedure. Early season forecasts assume average climatic conditions through the snowmelt season.

Listed below are the Federal-State-Private Cooperative Snow Survey and Water Supply Forecast reports available for the West which contain detailed information on snow survey measurements, streamflow forecasts, reservoir storage, soil moisture and other guide data to water management and conservation decisions. Soil Conservation Service Reports may be secured from Water Supply Forecasting Unit, Soil Conservation Service, P.O. Box 2807, Portland, Oregon 97208.

PUBLISHED BY SOIL CONSERVATION SERVICE

REPORTS	ISSUED	LOCATION	COOPERATING WITH
RIVER BASINS			
Western United States	Monthly (Feb.-May)	Portland, Oregon	All Cooperators
Basic Data Summary	October 1	Portland, Oregon	All Cooperators
STATES			
Alaska	Monthly (Mar.-May)	Palmer, Alaska	Alaska S.C.D.
Arizona	Semi-Monthly (Jan.15 - Apr.1)	Phoenix, Arizona	Salt R. Valley Water Users Assoc. Ariz. Agr. Exp. Station
Colorado and New Mexico	Monthly (Feb.-May)	Fort Collins, Colorado	Colo. State University Colo. State Engineer N. Mex. State Engineer
Idaho	Monthly (Jan.-June)	Boise, Idaho	Idaho State Reclamation Engineer
Montana	Monthly (Jan.-June)	Bozeman, Montana	Mont. Agr. Exp. Station
Nevada	Monthly (Jan.-May)	Reno, Nevada	Nevada Dept. of Conservation and Natural Resources - Division of Water Resources
Oregon	Monthly (Jan.-June)	Portland, Oregon	Oreg. State University Oregon State Engineer
Utah	Monthly (Jan.-June)	Salt Lake City, Utah	Utah State Engineer
Washington	Monthly (Feb.-June)	Spokane, Washington	Wn. State Dept. of Conservation
Wyoming	Monthly (Feb.-June)	Casper, Wyoming	Wyoming State Engineer

PUBLISHED BY OTHER AGENCIES

REPORTS	ISSUED	AGENCY
British Columbia	Monthly (Feb.-June)	Water Resources Service, Dept. of Lands, Forest and Water Resources, Parliament Bldg., Victoria, B.C., Canada
California	Monthly (Feb.-May)	Calif. Dept. of Water Resources, P.O. Box 388, Sacramento, Calif.

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ISSUED

MAY 1, 1964

The Soil Conservation Service coordinates snow surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, Corps of Engineers, Forest Service, National Park Service, Geological Survey, and other Federal Agencies, Departments of State Government, Irrigation Districts, Power Companies, and others.

The Department of Water Resources coordinates snow surveys in California.

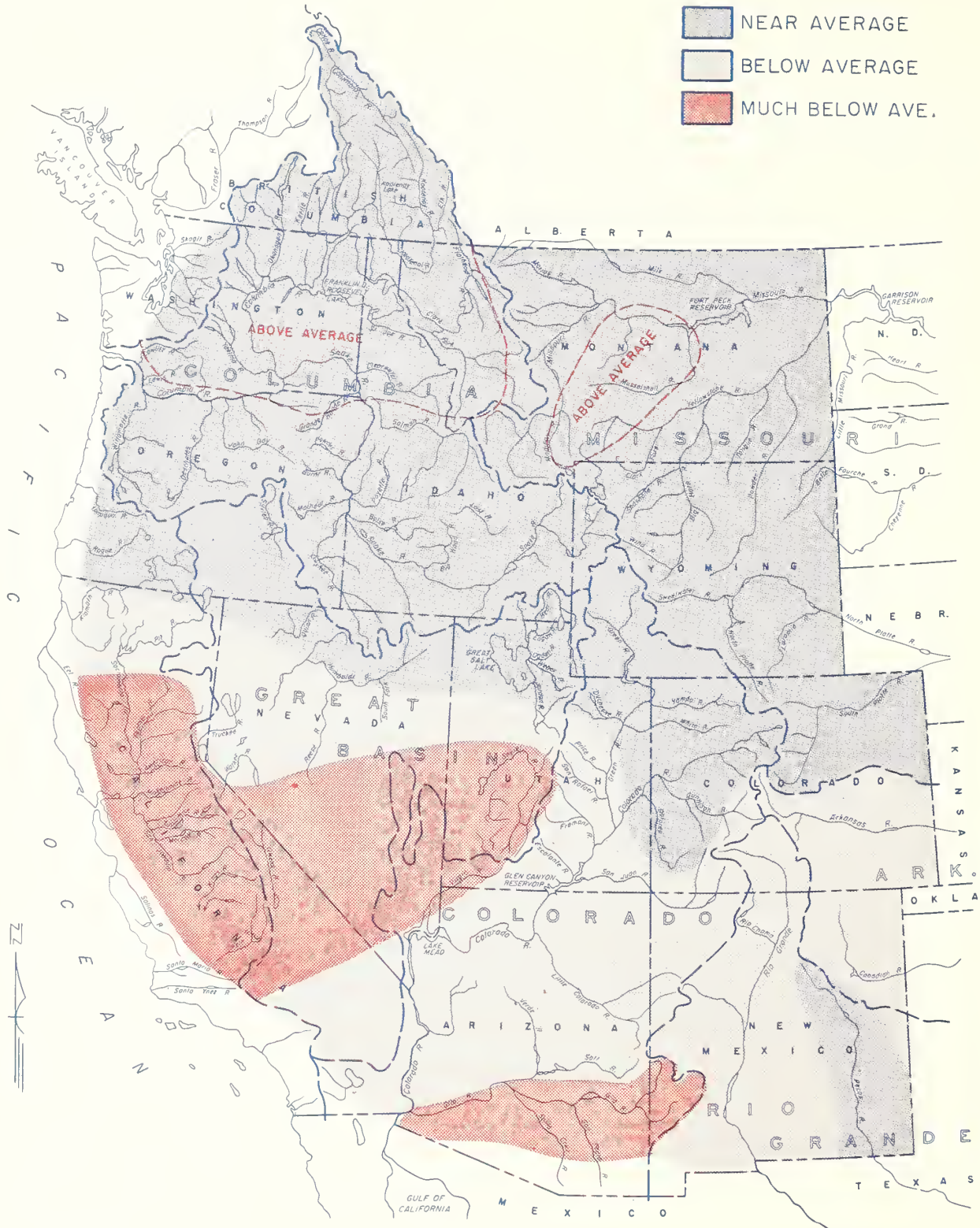
The Water Resources Service, Department of Lands, Forests, and Water Resources directs snow surveys in British Columbia.

This report was prepared by Homer J. Stockwell, under the direction of R. A. Work, Head, Water Supply Forecast Unit, Engineering Division, Soil Conservation Service, Portland, Oregon, from data supplied by Snow Survey Supervisors of the Soil Conservation Service: Arizona, Richard W. Enz; Colorado and New Mexico, Jack N. Washichek; Idaho, M. W. Nelson; Montana, Phil E. Farnes; Nevada, Manes Barton; Oregon, W. T. Frost; Utah, Gregory L. Pearson; Washington, Robert T. Davis; Wyoming, George W. Peak.

California....Dept. of Water Resources, V. H. Lemons, Chief, Water Supply Forecast and Snow Surveys Unit.

British Columbia....Dept. of Lands, Forests, and Water Resources, Harry I. Hunter. Meteorologist, Water Resources Service.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
D. A. WILLIAMS, ADMINISTRATOR



May - September, 1964
PROSPECTIVE STREAMFLOW
AS OF MAY 1, 1964

WATER SUPPLY OUTLOOK
As of May 1, 1964

WATER SUPPLY OUTLOOK VARIES FROM ADEQUATE IN THE PACIFIC NORTHWEST AND UPPER MISSOURI BASIN TO VARYING DEGREES OF SHORTAGE FOR THE SOUTHERN ROCKIES, THE SOUTHWEST, AND CENTRAL VALLEY OF CALIFORNIA.

Following a pattern established during the mid-winter months, water supplies will be adequate for all areas of the Pacific Northwest and the Upper Missouri Basin, with varying degrees of water shortage in prospect for the southern Rocky Mountain region and the Pacific Southwest. In general, climatic conditions during the month of April tended to increase streamflow forecasts slightly over those of a month ago.

Temperatures during April were well below average, resulting in a delay in snowmelt and the start of the rise in streamflow. Snowpack remaining in the mountains as of May 1 is high as compared to that for April 1. Many high elevation snow courses in the Columbia Basin approach the maximum of record for May 1. With the delay in the start of snowmelt, streamflow may be expected to be concentrated into a relatively short period, even if total seasonal flow is expected to be only slightly in excess of average. The distribution pattern of snowmelt depends largely on temperature sequences.

The most extreme shortages of water for 1964 are expected for the Arkansas and Rio Grande in Colorado and New Mexico and for the Sevier River of southwestern Utah. In these areas water supplies will be in excess of those of a year ago but much less than average.

Streamflow forecasts for the Colorado River and its tributaries increased slightly over April 1, but total flow expected will be among the lower 25 percent of the years of record. Lake Mead, while not at the lowest level of record (as was reported in error in this bulletin a month ago), is at the lowest level since the mid 1950's. Inflow will exceed that of a year ago.

Although streamflow forecasts are generally in excess of those of May 1, 1963, water supply outlook is not universally more favorable than that water supply which occurred in 1963. Last year, cool temperatures and late summer rains reduced water demands to well below average for much of the Pacific Northwest, the Great Basin and the California Central Valley. From a practical viewpoint, water supplies are generally comparable to a year ago except for the Central Valley of California.

The California Department of Water Resources reports that California water users can expect water supply conditions in general to be well below normal this summer. No critical deficiencies in irrigation supplies are anticipated as a result of near normal reservoir storage, but some curtailment will be required. The below normal water conditions are attributed to five consecutive months of below normal precipitation during the December through April period, the state's major rainfall season.

Water users in Nevada may expect a reasonably adequate water supply where they have access to storage. The total of surface storage and streamflow for the Central Valley of Arizona is much less than average.

Storage in irrigation reservoirs tends to be less than average and for this date in 1963. The adverse effects of this storage deficiency are most noted in southern Wyoming, Colorado, New Mexico and Arizona. Storage conditions are most improved in California and Nevada, and on the Snake River watershed in Idaho.

Isolated shortages may occur along smaller streams even where the regional outlook is good. Considerable variation in outlook is indicated between adjacent small watersheds. These are caused by a combination of high demands which require more than an average water supply to satisfy, and unsatisfactory carryover storage or streamflow prospects. Water users with interests in these areas are urged to check local water supply outlook reports.

MISSOURI BASIN

With an increase in streamflow forecasts since April 1, the flow of the Upper Missouri and its tributaries in Montana and Wyoming is now expected to be near average. The favorable outlook extends to a lesser extent to the Platte River headwaters in Wyoming and Colorado. Heavy storms since May 1 in the Montana area have further improved streamflow prospects. Water supplies are expected to be adequate for the upper basin with only limited shortages on the South Platte depending on summer demands.

MONTANA

Mountain snowpack ranges up to about 150 percent of average for May 1 for the Upper Missouri and 115 percent of average for the Upper Yellowstone. This is the result of moderate mountain precipitation and very little melt during April.

Many low and median elevation snow courses have measured snow water equivalents greater than any previous measurement for May 1. Streamflow forecasts are for about 90 percent of average for the Milk and Marias rivers and 120 to 130 percent of average for the Gallatin and mountain source streams in central Montana. Near average flows are anticipated for most other streams. With an improved outlook over April 1, water supplies are expected to be adequate even in late season unless the summer months are extremely dry.

WYOMING

Forecasts for Yellowstone River tributaries in Wyoming are now near average following an above average snowfall in late season. Water supplies in the Powell Basin and the east slope of the Bighorns are expected to be adequate. Buffalo Bill Reservoir on the Shoshone River is at a low level but will probably fill during snowmelt.

A substantial improvement in outlook has occurred since mid-winter on the North Platte. Inflow to Seminoe Reservoir is now expected to approach average for the summer months. Storage in North Platte reservoirs is much less than average, particularly in the larger upstream reservoirs. Total of storage and inflow will be adequate to meet usual irrigation water demands.

Locally, the Laramie Peaks range near Casper has an extremely heavy snowpack, about two times any measurement of the past ten years.

COLORADO (South Platte)

There was a slight improvement in water supply outlook over April 1, based on increased forecasts of natural streamflow within the basin. However, both streamflow forecasts and storage in irrigation reservoirs are less than average. A substantial source of water will be supplemental supplies from the Colorado-Big Thompson project. If demands are high, these reservoirs will be depleted at the end of the season. Reservoirs in the lower South Platte area have about average storage for this date.

ARKANSAS BASIN

Streamflow prospects have improved slightly since mid-winter, but the general outlook for irrigated areas along the Arkansas and its tributaries in Colorado remains poor. The forecast for the May-September flow is about three-quarters of average for the Arkansas at Salida. There is very little carryover storage and, unless there are heavy rains during snowmelt, there will be little opportunity to store from snowmelt water. Most reservoirs in valley areas are empty, including John Martin.

Seasonal snowpack on the watershed in New Mexico has been near average, but early season runoff has been deficient. Storage is much less than average and a year ago. Outlook is fair to good, depending on summer precipitation.

RIO GRANDE BASIN

Snowpack on the headwaters of the Rio Grande in Colorado and northern New Mexico was relatively high, almost average, at the 10,000 foot elevation on May 1. This improvement over April 1 is more the result of delay in snowmelt than of above average precipitation during April. Water supply in San Luis Valley will be much less than average but roughly 150 percent of the extremely low year of 1963. A similar outlook is in prospect for the Rio Grande through New Mexico. Supplemental use of groundwater will be a continued necessity. Reservoir storage remains at a minimum in both the San Luis Valley and in the large reservoirs of the main stem in New Mexico.

COLORADO BASIN

There was a slight improvement in streamflow prospects on the Colorado River and its tributaries during April. However, because of the extreme snowfall deficiencies during the winter months, snowmelt season runoff will again be much less than average but well in excess of the flow for the extremely low year of 1963. Snowmelt during April was negligible at medium and higher mountain elevations so April streamflow was below average. The relatively high snowpack in the upper basin is largely the result of a delayed snowmelt. April precipitation was only slightly in excess of average. Forecast for unimpaired inflow to Lake Mead for the May-September period is now 5,800,000 acre-feet or 71 percent of average for the period. (In the April issue of this report it was stated erroneously that Lake Mead was at the lowest level since the initial filling period. The reservoir contained up to 3,000,000 acre-feet less water at the low point for three separate years in the mid-1950 drouth period.)

COLORADO

West of the Continental Divide, forecasts of summer streamflow range from 60 percent of average on the San Juan up to near average for Yampa and White rivers in northwest Colorado. Water supplies will be adequate along the main streams. The possibility of late season shortages along smaller streams has diminished with slightly improved streamflow prospects and continued delay of the start of the snowmelt season. The outlook for the Dolores River improved during April but remains slightly below average.

SUMMARY OF SNOW WATER EQUIVALENT MEASUREMENTS

MAY 1, 1964

MAJOR BASIN AND SUB—WATERSHED	WATER EQUIVALENT IN PERCENT OF: LAST YEAR	AVERAGE
MISSOURI BASIN		
Jefferson	125	136
Madison	143	154
Gallatin	122	139
Missouri Main Stem	147	164
Yellowstone	104	116
Shoshone	80	101
Wind	105	108
North Platte	104	101
South Platte	125	88
ARKANSAS BASIN		
Arkansas	192	104
Canadian		
RIO GRANDE BASIN		
Rio Grande (Colo.)	277	92
Rio Grande above Otowi Bridge	360	97
Pecos		
COLORADO BASIN		
Green (Wyo.)	88	108
Yampa - White	166	128
Duchesne	115	127
Price	119	132
Upper Colorado	306	109
Gunnison	266	115
San Juan	106	57
Dolores	302	130
Virgin	220	140
Gila		
Salt		
GREAT BASIN		
Bear	104	124
Logan	109	114
Ogden	122	128
Weber	112	133
Provo - Utah Lake	106	143
Jordan	118	145
Sevier	112	110
Walker - Carson	24	40
Tahoe - Truckee	45	45
Humboldt	90	84
Lake Co. (Oregon)		
Harney Basin (Oregon)		
UPPER COLUMBIA BASIN		
Columbia (Canada)	138	115
Kootenai	162	110
Clark Fork	146	131
Bitterroot	157	140
Flathead	155	123
Spokane	258	143
Okanogan	156	117
Methow	110	101
Chelan	153	115
Wenatchee	300	120

MAJOR BASIN AND SUB—WATERSHED	WATER EQUIVALENT IN PERCENT OF: LAST YEAR	AVERAGE
SNAKE BASIN		
Snake above Jackson, Wyo.	125	101
Snake above Hiese, Idaho	110	125
Snake above American Falls Res	115	112
Henry's Fork		100
Southern Idaho Tributaries		
Big and Little Wood	80	80
Boise	123	90
Owyhee	159	100
Payette	130	90
Malheur	64	120
Weiser		90
Burnt		105
Powder		
Salmon	123	105
Grande Ronde		115
Clearwater	209	140
LOWER COLUMBIA BASIN		
Yakima	128	151
Umatilla	341	150
John Day		120
Deschutes - Crooked	232	100
Hood	307	135
Willamette	305	116
Lewis	253	111
Cowlitz	210	110
PACIFIC COASTAL BASIN		
Puget Sound	301	146
Olympic Peninsula		
Umpqua - Rogue	357	100
Klamath	240	108
Trinity		
CALIFORNIA CENTRAL VALLEY		
Upper Sacramento	50	55
Feather	45	40
Yuba	65	65
American	55	55
Mokelumne	45	50
Stanislaus	50	50
Tuolumne	50	50
Merced	50	50
San Joaquin	40	50
Kings	40	40
Kaweah	55	50
Tule	60	50
Kern	25	25

Data for California Watersheds supplied by Dept. of Water Resources, and for British Columbia Watersheds by Dept. of Lands, Forests and Water Resources.

Average is for 1943-57 period, except for California which is 1931-60.

Based on Selected Snow Courses determined by Distribution within the Basin, Length of Record and Repetitive Monthly Measurement Schedules.

SELECTED STREAMFLOW FORECASTS MAY - SEPTEMBER MAY 1, 1964

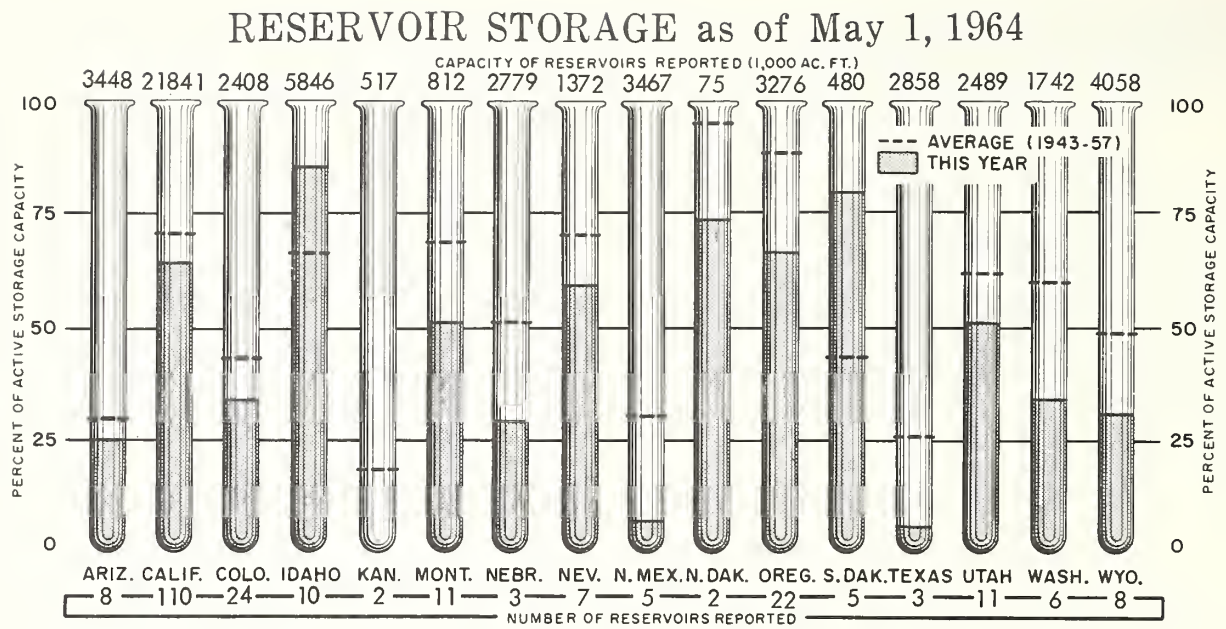
STREAM AND STATION	1000 ACRE-FEET		PERCENT OF AVERAGE
	FLOW 1963	FORECAST 1964	
UPPER MISSOURI			
Clark Fork at Chance, Montana	576	561	95
Gallatin near Gateway, Montana	430	511	118
Jefferson at Sappington, Montana	862	878	96
Madison near Grayling, Montana 1/	379	375	96
Missouri near Zortman, Montana 2/	3054	4110	99
Missouri near Williston, N. Dakota 3/	9836	9800	93
Yellowstone at Corwin Springs, Montana	1865	1800	96
Yellowstone at Miles City, Montana		5440	88
Shoshone below Buffalo Bill Res., Wyoming 4/		768	95
Wind at Dubois, Wyoming		74	80
PLATTE			
Clear at Golden, Colorado 5/		130	98
North Platte at Saratoga, Wyoming		505	88
Cache LaPoudre near Ft. Collins, Colorado 6/		151	82
ARKANSAS			
Arkansas at Salida, Colorado 7/		235	74
RIO GRANDE			
Rio Grande near Del Norte, Colorado 8/		320	71
Rio Grande at Otowi Bridge, New Mexico 9/		290	63
Pecos at Pecos, New Mexico *		41	100
UPPER COLORADO			
Animas at Durango, Colorado		365	86
Colorado at Glenwood Springs, Colorado 10/		1175	82
Colorado near Cisco, Utah	1310	2900	81
Colorado near Grand Canyon, Arizona 11/	3263	5800	71
Duchesne near Tabiona, Utah 12/		94	90
Green, Inflow to Flaming Gorge (Apr-July)	579	1100	86
Green near Green River, Utah 13/	1624	2590	84
Gunnison near Grand Junction, Colorado		950	78
Price near Scofield, Utah 14/		28	82
San Juan near Bluff, Utah 15/	434	640	61
White at Meeker, Colorado		300	99
Yampa at Steamboat Springs, Colorado		250	104
LOWER COLORADO			
Gila near Solomon, Arizona (Apr-May)	29	9	36
Salt at Intake, Arizona (Apr-May)	72	39	31
Verde above Horseshoe Dam, Arizona (Apr-May)	16	41	63
GREAT BASIN			
Bear at Harer, Idaho 16/		230	98
Logan near Logan, Utah 17/	94	110	88
Ogden, Inflow to Pine View Res., Utah 18/ (May-July)	61	82	106
Provo at Vivian Park, Utah 19/		115	89
Sevier at Hatch, Utah 20/	22	22	49
Sevier near Kingston, Utah		5	24
Humboldt at Palisades, Nevada **		100	61
Truckee at Farad, California ** 21/		130	74
West Walker near Coleville, California **		80	62

Forecasts in California provided by Department of Water Resources.
Average is for 1943-57 period except California. California is computed for 1911-60 period.
Forecasts assume average Effective Climatic Conditions from Date Through Snow Melt Season.

SELECTED STREAMFLOW FORECASTS MAY - SEPTEMBER MAY 1, 1964

STREAM AND STATION	1000 ACRE-FEET		PERCENT OF AVERAGE
	FLOW 1963	FORECAST 1964	
UPPER COLUMBIA			
Bitterroot near Darby, Montana	495	553	106
Chelan at Chelan, Washington 22/		1300	111
Clark Fork above Missoula, Montana	1246	1860	118
Clark Fork at Whitehorse Rapids, Montana 23/		13600	112
Columbia at Revelstoke, British Columbia		19500	111
Columbia at Birchbank, British Columbia 24/		42000	104
Columbia at Grand Coulee, Washington 24/		63800	105
Columbia at The Dalles, Oregon 24/		95000	103
Flathead near Polson, Montana 23/	5045	7190	109
Kootenai at Wardner, British Columbia		4300	98
Kootenai at Leonia, Idaho	7376	8200	103
Okanogan near Tonasket, Washington		1890	107
Spokane at Post Falls, Idaho 25/	1078	2650	125
SNAKE			
Big Lost, Inflow to Mackay Res., Idaho 26/	169	150	96
Big Wood near Hailey, Idaho	238	315	104
Boise above Diversion Dam, Idaho 28/	1124	1240	95
Clearwater at Spalding, Idaho	5048	8300	116
Malheur near Drewsey, Oregon	36	30	83
Owyhee Res. Net Inflow, Oregon 18/	239	200	93
Payette near Horseshoe Bend, Idaho 29/	1378	1540	95
Salmon at Whitebird, Idaho	6205	6150	97
Snake near Heise, Idaho 30/	3124	5400	93
Snake at Weiser, Idaho		5200	89
LOWER COLUMBIA			
Cowlitz at Castle Rock, Washington		2400	110
Deschutes at Benham Falls, Oregon 31/ (Apr-Sept)	499	530	88
Grande Ronde near LaGrande, Oregon	78	105	88
Hood near Hood River, Oregon 32/	171	280	104
Willamette at Salem, Oregon 33/ (Apr-Sept)		5008	92
Yakima near Parker, Washington 34/		1640	109
NORTH PACIFIC COASTAL			
Dungeness near Sequin, Washington		170	114
Rogue at Raygold near Central Point, Oregon	795	700	95
Klamath Lake, Net Inflow, Oregon 35/	373	380	88
CALIFORNIA CENTRAL VALLEY 36/**			
American, Inflow to Folsom Res., Calif.	1755	720	52
Feather near Oroville, Calif.	2653	900	46
Kaweah, Inflow to Terminus Res., Calif.	332	140	53
Kern near Bakersfield, Calif.	476	185	43
Kings, Inflow to Pine Flat Res., Calif.	1388	530	45
Merced, Inflow to Exchequer Res., Calif.	677	230	37
Mokelumne, Inflow to Pardee Res., Calif.	565	230	48
Sacramento, Inflow to Shasta Res., Calif. 37/	2995	1100	62
San Joaquin, Inflow to Friant Res., Calif.	1413	520	43
Stanislaus, Inflow to Melones Res., Calif.	842	360	49
Tule, Inflow to Success Res., Calif.	65	27	48
Tuolumne, Inflow to Don Pedro Res., Calif.	1435	550	45
Yuba at Smartville, Calif.	1430	630	56

Explanatory Notes on Forecasts Listed on Inside Back Cover.
** April - June Period ** April - July Period*



UTAH

Because of wet, cool conditions in Utah during April, water supply prospects improved substantially for Colorado River tributary streams since a month ago. Remaining snowpack is above average and a year ago. Streamflow for the May-September period is forecast in a general range of 60 to 90 percent of average. The delay in the start of snowmelt indicates that streams may peak at relatively high levels and hold up longer than could otherwise be expected from the total streamflow picture. The general outlook is fair and comparable to that which occurred in 1963.

ARIZONA

Storms of late March and early April, accompanied by above normal temperatures have resulted in better than anticipated runoff on the Salt River during April. The Gila watershed did not share materially in the storms of the period and runoff continues low. Runoff for the January-May period is expected to be 63 percent of average on the Verde and 40 percent on the Salt and Gila rivers.

Reservoir storage has declined as demands exceed inflow. Total storage is 83 percent of average for this date for central Arizona. Heavy supplemental pumping will be required to meet water requirements.

GREAT BASIN

UTAH

April weather brought a marked improvement in water supply outlook for the Great Basin section of northern Utah. Streamflow forecasts range from 75 to 120 percent of average. The general outlook is fair to good for the Salt Lake-Ogden-Logan area. Outlook remains poor for the Sevier and smaller streams in the general area of southwestern Utah. May snowpack is relatively high as a result of well above average precipitation during April and a delay in snowmelt.

NEVADA

The water supply outlook for Nevada has not changed materially since April 1. Snowmelt and streamflow have been near average for the month. Except for the Carson Valley, most irrigation water users from east slope of Sierra streams will have an adequate water supply with reservoir water offsetting streamflow deficiencies. Forecasts of flow for the Tahoe-Truckee, Carson and Walker basin headwater streams range from about one-half to three-quarters of average for the May-July period. Water supply outlook remains relatively good on the Humboldt and its tributaries with slightly below average streamflow in prospect. April precipitation tended to be deficient in the Sierras and slightly above average in the Humboldt.

COLUMBIA BASIN

As indicated throughout the winter season, water supplies throughout the Columbia Basin and its tributaries will be adequate for 1964. In common with most other mountain areas of western states, snowmelt has been delayed. May 1 snowpack ranges from 110 percent of average on the Kootenai watershed up to near 140 percent of average on the Spokane, Clearwater and Yakima watersheds. The upper Snake

STORAGE IN LARGE RESERVOIRS

MAY 1, 1964

BASIN AND NAME OF RESERVOIR	CAPACITY (1000 A.F.)	STORAGE (1000 A.F.)
UPPER MISSOURI		
Boysen	560	239
Buffalo Bill	380	98
Canyon Ferry	2043	1741
Hebgen	385	225
Tiber	1316	632
Belle Fourche	185	156
Keyhole	190	77
Fort Peck	19400	11920
Fort Randall	6100	4019
Garrison	24500	12539
Oahe	23600	8775
PLATTE		
Glendo	786	434
Pathfinder	1011	226
Seminoe	982	120
Colo-Big Thompson (4)	865	395
City of Denver (4)	218	96
ARKANSAS		
Conchas	600	81
John Martin	367	0
RIO GRANDE		
Elephant Butte	2207	124
El Vado	194	3
UPPER COLORADO		
Flaming Gorge	3789	945
Navajo	1709	373
Powell	28040	2656
LOWER COLORADO		
Havusu	619	597
Mead	27207	14564
Mohave	1810	1715
San Carlos	1206	41
Salt River Res. (4)	1755	722
Verde River Res. (2)	322	83
GREAT BASIN		
Bear	1421	803
Lahontan	286	220
Rye Patch	179	97
Sevier Bridge	236	66
Strawberry	270	64
Tahoe	732	352
Utah	1149	395

BASIN AND NAME OF RESERVOIR	CAPACITY (1000 A.F.)	STORAGE (1000 A.F.)
UPPER COLUMBIA		
Chelan	676	122
Coeur d'Alene	238	242
Flathead	1791	1342
Hungry Horse	2982	2003
Kootenay	817	457
Pend Oreille	1155	843
Roosevelt	5232	2983
LOWER COLUMBIA		
Detroit	300	232
Hills Creek	351	317
Lookout Point	456	382
Yakima Res. (5)	1065	474
SNAKE		
American Falls	1700	1711
Arrowrock	287	279
Anderson Ranch	423	364
Brownlee	1427	1363
Cascade	653	396
Jackson	847	635
Lucky Peak	278	211
Palisades	1202	1021
Owyhee	715	625
PACIFIC COASTAL		
Clear Lake	440	166
Upper Klamath	584	481
Ross	1203	718
Trinity	2500	2168
CALIFORNIA CENTRAL VALLEY		
Almanor	1036	760
Berryessa	1602	1541
Cachuma	205	162
Casitas	254	45
Cherry Valley	268	62
Don Pedro	290	220
Folsom	1010	683
Hetch-Hetchy	360	128
Isabella	570	172
McClure	281	166
Millerton	521	341
Nacimiento	350	182
Pardee	210	189
Pine Flat	1013	622
Shasta	4500	3301

Reservoir Storage Data Provided by Bureau of Reclamation, Corps of Engineers, Geological Survey, and water using organizations. Data from California and British Columbia provided by Department of Water Resources and Department of Lands, Forests and Water Resources, respectively.

watershed above Lewiston has substantially less--near average--snowpack remaining as of May 1. Streamflow has been more nearly typical for April.

May 1, 1964 snowpack for the upper Columbia water equivalent is comparable to 1950 and 1956 snowpack for this date. A potential for relatively high flows along the lower Columbia exists, the amount depending on temperature sequence and amount of control that can be obtained from presently available storage space. The forecast for the May-September period for the Columbia at The Dalles is 95,000,000 acre-feet or 103 percent of the 1943-57 average period.

BRITISH COLUMBIA

The Water Resources Service reports that snow course measurements made near May 1 indicate that mountain snow is above average in most of the mountain watersheds, with this heavier than usual snow particularly applicable at low elevations. This has been caused by April's cool weather which has delayed low level snowmelt. Future weather, in particular, future melt rates, will determine just when and how this snow becomes streamflow. Continuation of the present cool weather could lead to a heavy buildup of snow in late May and provide one of the necessary prerequisites for a high water potential.

River flow forecasts for the period May through September call for close to average volume for the Kootenay, Columbia and Fraser rivers. Exceptions are the slightly above average May-July forecasts for the Okanagan-Similkameen rivers and well above average forecasts for the inflow to the Nechako Reservoir.

IDAHO

Water supplies are forecast to be close to normal throughout the entire state. Storage and streamflow will be adequate to meet water requirements.

The cool temperatures retarded snowmelt and resulted in below normal runoff during April. Nearly the same volume of water is forecast to flow during the May through September period as was expected for April through September. The Spokane River is a good example. The April through September volume forecast on the Spokane River was 105 percent of its normal on April first. When the actual flow for April was subtracted from this forecast, the May through September period increased to 125 percent of its average. A similar situation exists on the Clearwater River and, to a lesser degree, on all of the rivers in Idaho.

Soil moisture stations throughout the state indicate excellent soil moisture as a result of the melting snow. Reservoir stored water throughout the state varies from good to excellent and adjustments are being made to make the most efficient use of seasonal flow.

MONTANA

Mountain precipitation during April was generally below average and very little melt occurred at the lower and median elevations. Many snow courses have water equivalents that exceed previous May 1 records. In all areas it is about 150 percent of that measured last year at this time.

With streamflow during April near one-half average and increase in the snowpack, forecasts for the May through September streamflow have increased up to 100 to 120 percent average.

Rapidly warming temperatures could produce high flows in the streams and rivers as snowmelt will occur at all elevations. However, moderate or below average temperatures and precipitation will allow the snowpack to melt without abnormally high flow.

OREGON

Cooler than average temperatures prevailed during April which delayed snowmelt at higher elevations and retarded streamflow. Reservoir storage is favorable, and streamflow for the remainder of the season is expected to be near average. Adequate water supplies are anticipated for all irrigated areas except for McKay Reservoir near Pendleton where some late season shortages are likely.

Snowpack as of May 1 tends to be well above average in the lower Columbia Basin area and near average in the Rogue-Umpqua headwaters. Snowpack continues to accumulate at the high elevations.

WASHINGTON

The water supply outlook for irrigation and power continues to be good. Weather has been cold and wet during the month of April which has retarded snowmelt and added water to the snowpack at both low and high elevations. Forecasts of streamflow have generally been improved over that which was reported last month. This is a result of the lack of runoff during the month of April as well as the improved snow picture in the hills. Reservoir storage continues to be low and some reservoirs have been pulled down further due to the start of the irrigation season. It is still anticipated that all reservoirs will fill with the spring runoff. Delay in runoff will tend to concentrate seasonal runoff into higher than typical peak flows from a near average runoff.

CALIFORNIA

The California Department of Water Resources, coordinating agency for snow surveys and water supply forecasting in California, reports that water supplies throughout the state this summer will be well below normal. Data as of May 1 show that although there is no cause to expect critical deficiencies in irrigation supplies, the situation is such as to require overall prudent use of water. May 1 forecasts of runoff throughout California are all below those of April 1, reflecting the general condition of below normal precipitation during April.

Although water conditions in California will generally be far below normal this year, most areas of the state have an import supply, a sufficient storage supply (surface and/or underground), or both which will adequately carry them through a dry season. The greatest concern in California when a dry year such as this one occurs is, whether or not it is an isolated incident such as occurred during the 1946-47; 1954-55; and 1956-57 water years, or the beginning of a series of dry years such as the periods of 1946-47 through 1948-49 and 1958-59 through 1960-61, to say nothing of the extensive drought period that began with the 1927-28 water year.

Although May 1 forecasts of runoff for California river basins are generally below those made as of April 1, the May 1 forecasts of river basins in the southern part of the Central Valley generally decreased only slightly (5 percent or less) for the April-July period. On the other hand, May 1 forecasts of April-July flows of the northern part of the Central Valley are from 5 to 20 percent lower than the forecasts of one month ago.

Precipitation in California during April was 40 percent of average. Thus, April was the fifth consecutive month this season that precipitation in California has been below normal. Although there were some areas where normal or above normal precipitation occurred, over a third of the state had less than 20 percent of normal precipitation during the month. In the Central Valley area, precipitation for April varied from a low of 20 percent of normal for the Pit River basin to a high of 90 percent of normal for the Kaweah and Tule river basins.

In southern California, the precipitation during April for the South Coastal area was approximately 80 percent of normal. This was sufficient rainfall to significantly improve the streamflow in the area over that experienced in preceding months this year. Although this did not improve the water supply to any great degree, it did stall off the forest fire season, a factor of some consequence in this area.

The accumulated snowpack as of May 1 is also well below normal for this date throughout the state with the exception of the South Coastal area. Although the effect of snowpack on water supply is normally inconsequential for this area, the snowpack in the upper watersheds of the Santa Ana, San Gabriel and Cottonwood basins is near or above normal for this date. Reflecting the five consecutive months of below normal precipitation, the May 1 snowpack in the Central Valley ranges from 50 percent of normal in the northern Sierra to 60 percent of normal in the southern Sierra.

Runoff during April in California was substantially below average over the entire state. The runoff pattern established as of March 1, following the near record-breaking dry February, was generally continued throughout April, with the streamflow from coastal streams being only a small percentage of that expected for April. In the Central Valley, runoff during April was 55 percent of normal, ranging from a high of 65 percent of normal for the Mokelumne River basin to a low of 45 percent for the Kern River basin.

Reservoir storage as of May 1 is only slightly below average for this date. This favorable situation exists despite early seasonal irrigation demands and subnormal reservoir inflow to date, due to prudent reservoir operation and above average carryovers from last year.

EXPLANATION of STREAMFLOW FORECASTS

1/ Observed flow adjusted for change in storage in Hebgen Lake. 2/ Observed flow adjusted for change in storage in Canyon Ferry and Tiber reservoirs. 3/ Observed flow adjusted for change in storage in Canyon Ferry, Tiber, Fort Peck, Buffalo Bill, and Boysen reservoirs. 4/ Observed flow adjusted for change in storage in Buffalo Bill Reservoir plus Heart Mt. Diversion. 5/ Observed flow minus diversion through Jones Pass Tunnel.

6/ Observed flow minus diversions from North Platte, Colorado, and Laramie rivers plus measured diversions for irrigation and municipal use above station. 7/ Observed flow adjusted for change in storage in Clear Creek, Twin Lakes, and Sugar Loaf reservoirs minus trans-mountain diversions through Busk-Ivanhoe and Twin Lakes tunnels and Ewing, Fremont, Wurtz, and Columbine ditches. 8/ Observed flow adjusted for change in storage in Santa Maria, Rio Grande, and Continental reservoirs. 9/ Observed flow adjusted for changes in storage in reservoirs listed in (8) plus Terrace, Sanchez, Platoro, and El Vado reservoirs. 10/ Observed flow adjusted for changes in storage in Granby Reservoir plus diversions through Adams Tunnel and Grand River Ditch.

11/ Observed flow adjusted for changes in storage in Flaming Gorge, Navajo, and Lake Powell. 12/ Observed flow plus diversion through Duchesne Tunnel. 13/ Observed flow adjusted for changes in storage in Flaming Gorge and Big Sandy reservoirs. 14/ Observed flow adjusted for change in storage in Scofield Reservoir. 15/ Observed flow adjusted for change in storage in Navajo Reservoir.

16/ Observed flow. 17/ Observed flow plus Utah Power and Light Tailrace and Logan, Hyde Park, and Smithfield canals. 18/ Record computed by Bureau of Reclamation. 19/ Observed flow adjusted for change in storage in Deer Creek Reservoir, minus diversions through Duchesne Tunnel and Weber-Provo Canal, plus diversion through Salt Lake Aqueduct. 20/ Observed flow.

21/ Observed flow exclusive of Lake Tahoe and adjusted for change in storage in Boca Reservoir. Forecast by Truckee Basin Water Committee. 22/ Observed flow adjusted for change in storage in Lake Chelan. 23/ Observed flow adjusted for change in storage in Flathead and Hungry Horse reservoirs. 24/ Observed flow adjusted for change in storage in any or all of the following reservoirs above the station: Kootenay, Hungry Horse, Flathead, Pend Oreille, Coeur d'Alene, F. D. Roosevelt, Lake Chelan, Noxon, and Brownlee; and pumping from F.D.R. Lake. 25/ Observed flow adjusted for change in storage in Coeur d'Alene Lake plus diversions to Spokane Valley Farms and Rathdrum Prairie canals.

26/ Observed flow adjusted for change in storage in Mackay Reservoir plus diversion in Sharp Ditch. 27/ Combined flow of Big Wood near Belleview and Camas Creek near Blaine. 28/ Observed flow adjusted for changes in storage in Lucky Peak, Anderson Ranch, and Arrowrock reservoirs. 29/ Observed flow adjusted for changes in storage in Cascade and Deadwood reservoirs. 30/ Observed flow adjusted for changes in storage in Palisades and Jackson reservoirs.

31/ Observed flow adjusted for changes in storage in Crane Prairie, Wickiup, and Crescent Lake reservoirs. 32/ Adjusted to natural flow. 33/ Observed flow adjusted for changes in storage in Lookout Point, Detroit, Cottage Grove, Dorena, and Hills Creek reservoirs. 34/ Observed flow adjusted for changes in storage in Keechelus, Kachess, Cle Elum, Bumping, and Tieton reservoirs, plus diversions by Rosa, New Reservation, Old Reservation, and Sunnyside canals. 35/ Flow records provided by PP&L and USBR.

36/ All forecasts are for unimpaired streamflow except Kaweah River. 37/ Not corrected for upstream impairments. All other forecasts are for observed flow.

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